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Effect of Soil Environment on Maize

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Abstract: One of the most significant cereal crops in the world is maize (Zea mays), which is both a useful feedstock for different industries and a staple diet. The soil environment in which maize is grown has a big impact on its development and production. The goal of this review article is to give a thorough understanding of how soil characteristics, nutrient availability, soil moisture, and soil microbes all affect the development and production of maize. For maize production to be optimised and sustainable agricultural practises to be developed, it is essential to comprehend these interconnections.

On a field size, the soil characteristics of agricultural areas with various cultivation eras exhibit a significant degree of spatial variation. Although soil characteristics were not taken into account when allocating irrigation water at the irrigation district level, this led to shortages or surpluses of irrigation water in farmlands with various types of soils. Accurately determining regional irrigation water demands and water-saving potential requires a thorough understanding of the impacts of soils on crop IWP and irrigation water requirements..

Keywords: Maize, Zea Mays, Soil Environment, Soil Properties, Nutrient Availability, Soil Moisture, Soil Microorganisms, Sustainable Agriculture, Crop Productivity.

Introduction:

Corn, commonly referred to as maize, is one of the most significant staple crops in the world. It is a crucial source of food, animal feed, and raw materials for industry. A number of elements, including the soil environment, have a substantial impact on the effectiveness of maize farming. The general health, production, and pest and disease resistance of maize plants are all significantly influenced by the soil in which they are grown. Both farmers and researchers must understand how the soil environment affects maize since doing so will help them improve farming methods and increase crop output.

Life Cycle Assessment:

One of the most effective tools for statistically evaluating the environmental performance of different agricultural strategies among the variety of measuring approaches is life-cycle assessment (LCA) across the agriculture production system. LCA across agriculture production systems is recognised as one of the most enlightening measuring methodologies among the several approaches available for quantitatively evaluating the environmental performance of various agricultural practises.

Traditionally, LCA has been used to analyse industrial production processes, but during the past 15 years, it has been upgraded to assess the environmental impacts of agriculture. In order to take the environmental impact of agriculture production into consideration, there are a variety of farming categories to consider as well as field-specific difficulties (such as varied geographical circumstances, crop rotation, and seasonal changes). LCA is a thorough method for analysing how a product will affect the environment over its entire life cycle, from raw material extraction to manufacture, distribution, usage, and disposal or recycling (Figure 1). It works well for estimating and evaluating the possible environmental effects of various agricultural production methods [14]. The influence of food on the environment or ecosystem can be better understood thanks to LCA of agricultural goods. By implementing the options suggested by the LCA model through product comparison, life cycle evaluation also enables farmers to maximise productivity.

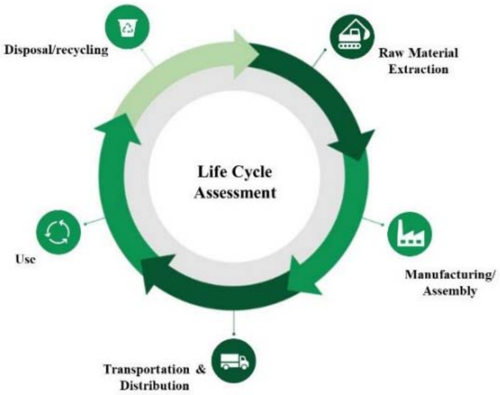

Fig.1 Product life cycle by LCA

Maize as a Crop:

One of the most adaptable crops, maize is capable of growing in a wide range of agro-climatic situations. Maize is known as the "Queen of Cereals" because it has the greatest genetic yield potential of any grain. To create more sustainable maize production systems, a thorough investigation that provides additional details on the effects of various agricultural practises on the environment is required. The current study employed the life cycle technique to determine the environmental effects of maize production in order to close any gaps and provide a more thorough assessment of the environmental impact of farming practises..

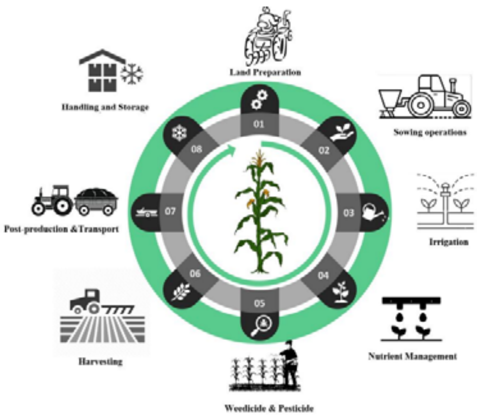

Fig. 2 Life Cycle of Maize Production

Soil Composition and Structure: The composition and structure of the soil significantly impact the growth of maize plants. A soil with a healthy mix of organic matter, minerals, and water-holding capacity is preferred for maize. The physical characteristics of the soil, such as its porosity, depth, and texture, have an impact on how well roots can absorb nutrients. While clay soils hold water but can become compacted, inhibiting root development, sandy soils readily drain water but may have inadequate nutrient retention. Loamy soils with a balanced mix of sand, silt, and clay offer optimal conditions for maize growth.

Nutrient Availability and Fertility: The availability of essential nutrients in the soil is crucial for maize plants to achieve their full potential. Macronutrients such as nitrogen (N), phosphorus (P), and potassium (K), as well as micronutrients like iron (Fe), manganese (Mn), and zinc (Zn), are vital for maize growth and development. Soil fertility, determined by the nutrient content and pH level, directly influences nutrient availability to plants. Strong plant growth, increased grain output, and enhanced resilience to pests and diseases are all benefits of adequate nutrition levels. Maintaining ideal nutrient levels in maize fields may be achieved with the use of soil testing and fertiliser application.

pH and Soil Acidity/Alkalinity: The pH level of the soil profoundly affects maize plants' ability to access nutrients. Most maize varieties prefer slightly acidic to neutral soil conditions (pH 5.8-7.0). Extreme soil pH values can cause toxicities or nutritional shortages. Alkaline soils (high pH) can cause deficits in iron and manganese whereas acidic soils (low pH) can restrict the availability of minerals including phosphorus, calcium, and magnesium. Adjusting soil pH through lime or sulphur applications can help create an environment conducive to maize growth.

Water Management and Drainage: Adequate water supply is vital for maize plants, especially during critical growth stages such as pollination and grain fill. The soil's capacity to store and release water affects plant water intake as well as the total availability of moisture. Waterlogging brought on by inadequate drainage can harm the health of the roots and deprive them of oxygen. Additionally, too much soil moisture might encourage the spread of fungi infections. Proper irrigation practices, coupled with efficient drainage systems, ensure optimal soil moisture levels, reducing the risk of water stress and associated yield losses.

Soil Health and Microbial Activity: The soil environment is a complex ecosystem that supports a diverse range of beneficial microbial communities. These bacteria are essential for the breakdown of organic matter, the cycling of nutrients, and the control of illness. The availability of nutrients is enhanced and soil-borne diseases that might harm maize plants are suppressed in healthy soils with a large microbial population. Crop rotation, the addition of organic matter, and the reduction of chemical inputs are examples of soil management techniques that can improve the health and microbial activity of the soil, eventually promoting the development and productivity of maize.

Disease and Pest Management:
The effects of diseases and pests on maize crops might be exacerbated or reduced depending on the soil environment. Some soil-borne diseases, such the Fusarium and Pythium species, can seriously harm maize roots and impair plant health in general. Proper soil management practices, including crop rotation, seed treatment, and residue management, can help suppress these pathogens and reduce disease incidence. Similarly, certain insects and nematodes inhabit the soil and can negatively impact maize plants. Soil-borne pests can be efficiently controlled by implementing integrated pest management techniques and adopting resistant maize types.

Cultural Practices:
Zea mays L. (cultivar PMH-1) was seeded on June 27 and June 22 of 2012 and 2013, respectively, at a spacing of 60 cm 20 cm (row to row and plant to plant spacing), after subsoil treatments. At the time of sowing, the required amounts of P, K, and Zinc Sulphate (at rates of 60, 30 and 25 kg ha-1, respectively) and one-third of the prescribed quantity of nitrogen (as urea) were applied. The remaining nitrogen was then administered in two equal splits, at knee high and at the pre-tasselling phases. The Punjab Agricultural University's suggested cultural practises, including fertilisers, herbicides, insecticides, and other management techniques, were implemented to guarantee adequate weed, pest, and disease control.

Plant Observations:
Plant height was measured using a 2.5 m measuring scale at the time of harvest as the mean height of five randomly chosen plants from the base of the plant to the base of the first leaf. Hands were used to harvest the produce at ground level from a 15 m2 area in the middle of each 4 × 6 m allotment. Each net-harvested plot's whole crop of ears was sun dried and shelled using a thresher. Following threshing, the grains were weighed to assess the moisture content of the grains from each plot. While the straw production was given on an oven-dry basis, the grain yield (t ha-1) was adjusted to a 15% moisture level.

Root Observations:
At knee height and the pre-tasting stage, soil core samples were taken from depths of 0–15, 15–30, 60–90, and 90–120 cm using a root sampling core with an internal diameter of 7 cm. In each experimental

plot, the plant base was left in the centre of the core when collecting samples for root extraction. By passing the core samples through a 1 mm screen while under flowing water, the roots were removed. The cleaned roots were baked at 600°C until their weight remained consistent. The ratio of the weight of the roots in a certain soil layer to the volume of the soil from which the roots were removed was used to compute the root density (g m-3 of soil).

Conclusion:

The soil environment plays a critical role in the growth, development, and productivity of maize. Understanding the various aspects of the soil, such as its composition, fertility, pH, water management, and microbial activity, is essential for optimizing maize cultivation. By implementing appropriate soil management practices, farmers can enhance nutrient availability, control diseases and pests, and promote overall plant health. Ultimately, a healthy soil environment lays the foundation for successful maize production, ensuring food security and economic sustainability.

The enormous impact of the soil environment on maize development and productivity is summarised in this review paper. In order to produce maize sustainably, agricultural management practises must take into account soil characteristics, nutrient availability, soil moisture, and soil microorganisms.

References:

1. Singh J, Salaria A, Kaul A. (2015) Impact of soil compaction on soil physical properties and root growth: A review. Inter J Food Agric Vet Sci 5:23-32
2. Hamza MA, Al-Adawi SS, Al-Hinai KA. (2011) Effect of combined soil water and external load on soil compaction. Soil Res 49: 135–142.
3. Mosaddeghi MR, Mahboubi AA, Safadoust A. (2009) Short-term effects of tillage and manure on some soil physical properties and maize root growth in a sandy loam soil in western Iran. Soil Till Res 104: 173–179.
4. Singh J, Hadda MS. (2015) Maize (Zea mays L.) response to subsoil compaction and nitrogen fertilization under semi-arid irrigated conditions. J Appl Nat Sci 7: 493–500.
5. Zand-Parsa S, Sepaskhah AR. (2001) Optimal applied water and nitrogen for maize. Agric Water Manage 52: 73-85.
6. Munkholm LJ, Kay BD. (2002) Effect of water regime on aggregate-tensile strength, rupture energy, and friability. Soil Sci Soc Am J 66: 702-709.
7. Bulinski J, Niemczyk H. (2001) Effect of method of agricultural outfit running on the field on soil properties and sugar beet yielding. Annals Warsaw Agricu Univ Agric Engg 41:39–44.
8. Grzesiak MT. (2009) Impact of soil compaction on root architecture, leaf water status, gas exchange and growth of maize and triticale seedlings. Plant Root 3:10-16.
9. S. Huysveld et al., “Resource use assessment of an agricultural system from a life cycle perspective – a dairy farm as case study,” Agric. Syst., vol. 135, pp. 77–89, 2015, doi: https://doi.org/10.1016/j.agsy.2013.12.008.
10. “IBEF,” Indian Brand Equity Found., vol. 8, no. 3, pp. 729–736, 2020, [Online]. Available: https://www.ibef.org/industry/agriculture-india.aspx.
11. J. A. Foley et al., “Solutions for a cultivated planet,” Nature, vol. 478, no. 7369, pp. 337–342, 2011, doi: 10.1038/nature10452.
12. Kslat, “The global need for food, fibre and fuel,” vol. 151 (4), p. 96, 2012.